How to Reduce the Electromagnetic Radiation in Your Home

Writing a document on this topic is a project without end because it is so complicated. So I will issue new versions whenever I have the time to reflect new or better information. If you find a superb document on this topic, kindly alert me.

Introduction

You can reduce your exposure to electromagnetic radiation by moving from wireless technology to wired technology, and by abandoning wireless devices that cannot be used wired. Fortunately, there is life after wireless technology, and a much healthier life at that. And wired technology will enable you to enjoy nearly all of the benefits of the Internet. Further, many wired products are cheaper, faster, and more cyber secure than their wireless counterparts. The principal sacrifices in going wired will be loss of mobility, reduced convenience, and the cost of making the changes, particularly the cost of wiring your home, and the cost of replacing or discarding wireless products that cannot be used wired.

Abandoning wireless devices has advantages not only for you, but also for those around you. Whenever a wireless device is used in the presence of others, everyone within a biologically active distance is exposed. That distance can easily include hundreds of individuals in some environments; each of them receives a mandatory exposure when you use a wireless device.

The Role of Your Technical Knowledge, and the Need for Professional Assistance

The suggestions below will help you lower the wireless radiation that you generate in your own home. Unfortunately, some suggestions may be beyond your technical knowledge to implement, so professional assistance may be needed. Address first the suggestions that you can implement.

There are at least three tasks that may require professional assistance. What follows is a brief discussion of each.

Identifying the Sources of Radiation

You may find that you need to make radiation measurements to determine which devices are radiating. See the section “Measuring Electromagnetic Fields” on page 13 for some preliminary

comments on measuring fields.

A professional trained in making such measurements of electromagnetic fields is recommended for this task.

Working on your Home's AC Power System

Some changes, particularly those that relate to unintentional radiators, will require working on your home's AC wiring. You should never attempt such work without the proper training and equipment for at least these reasons:

- You could do considerable harm to yourself and your family, because the voltages in use are lethal.
- You could do considerable harm to your home and to your electronic and electrical equipment, including starting fires.
- You could produce violations of the applicable electrical codes for your area, which could have safety and liability implications.

A licensed electrician is the best person to work on your home's AC power system.

Installing Shielding

To shield your home or parts of it, some knowledge of shielding materials and installation methods, and related measurement instrumentation, is required. Done improperly, shielding can make matters worse rather than better.

A professional in shielding is recommended for this task. Sometimes individuals with the proper knowledge and equipment for measuring electromagnetic fields will also have the knowledge to install shielding, but not always.

Intentional Versus Unintentional Radiators

I have divided the following discussion of radiating devices into two parts: intentional radiators and unintentional radiators. Intentional radiators are those that emit electromagnetic radiation that is necessary for their function. A cell phone is an example of such a device. Unintentional radiators are those that emit electromagnetic radiation that is not necessary for their function, but rather is a byproduct of their electronic nature. An example is the AC-to-DC wall power supply shown in Figure 1. Most of these wall power supplies contain switching

Figure 1: Wall AC-to-DC Power Transformer

technology, which generate both dirty electricity[1] and electromagnetic radiation. These wall power supplies power an enormous number of electronic devices.

Degrees of Radiation Reduction

For most radiating devices, you can choose the degree to which you want to reduce the radiation. For example, for many radiating devices, you have the following three choices. Radiation reduction increases as you progress down the list:

- Turn the radiating device ON during the day when it might be used, and turn it OFF during the night when it will not be used.
- Turn the radiating device ON only when you need it, and leave it OFF all of the rest of the time.
- Turn the radiating device OFF permanently (and discard it).

In the suggestions that follow for specific electronic devices, the above three options will often be available to you; so I won't repeat them for each device. Rather, I will describe the maximum reduction case. Occasionally, I will describe lesser levels of reduction when the method to be employed is not a simple choice from the above list.

In What Order Should You Address Radiating Devices?

The order can be influenced by a number of factors, including at least these:

- Which persons are most threatened by the wireless devices? (Best to address babies and pregnant mothers first, in my view, because of their very high degree of vulnerability.)
- Which wireless devices are easiest to address? Generally, intentional radiators are easier to address than unintentional radiators.
- Which wireless devices emit the most threatening levels of radiation?
- Which wireless devices are you technically able to address?
- Which wireless devices provide services that you are most willing to forego?
- Which changes can you best afford?

Since the factors that influence order are particular to each situation and individual, it is not possible to offer a universal order. But the order provided below will give you a place to start. Because, as noted above, it is usually easier for people to address the intentional radiators than the unintentional radiators, the intentional radiators are listed first. But, the overriding goal is to reduce the levels of radiation as quickly as possible, especially if you are already symptomatic from excess exposure to such radiation.

[1] Dirty electricity is electricity whose waveform departs from the smooth 60 hertz sinewave that the electric power company is supposed to deliver.

Shut Down Intentional Radiofrequency Radiators

Most of the intentional radiators that you encounter in your home will operate at frequencies from about 300 megahertz (millions of hertz) to 8 gigahertz (billions of hertz). These frequencies fall within a very broad range of frequencies called *radiofrequencies.* And, depending on the definition employed, these frequencies are also called *microwave* frequencies.

Wireless Baby Monitor

- Turn OFF and discard any wireless baby monitor.

    - Replace with a wired baby monitor, if needed, but do not locate even a wired baby monitor any nearer to a baby than necessary, since all electronic devices produce some electromagnetic emissions, even those that are not intentional radiators.

Cordless Telephones

- Replace cordless (wireless) telephones with corded (wired) telephones.

    - Fortunately, the corded ones are less expensive and usually have better sound quality.
    - Some, and possibly most, base stations for cordless telephones transmit all the time, not just when you are using one of the wireless handsets.
    - Unfortunately, even corded telephones, if they are loaded with features such as liquid crystal displays and Caller ID, may have some emissions, from their switching power supplies, or from their digital electronics, or from both.
    - The emissions from corded telephone generally increase as you go down this list:
        - It is powered entirely from the telephone line (best choice).
        - It is powered by internal batteries (second best choice because the electronic circuits are likely to be radiating, and a bit inconvenient because of the need to replace batteries).
        - It needs external power from the power line (probably a bad choice because the power supply is likely a switching type and because the electronic circuits are radiating and are likely more powerful than the electronic circuits in the battery-powered corded phone.

          (It may be possible to improve on the above distinctions later.)

Wi-Fi (Wireless Internet Modem/Routers)

- Turn OFF the Wi-Fi feature of your Internet modem/router and leave it OFF permanently.

    - Begin by connecting your principal computer to your modem/router with an Ethernet

cable.
  - Then contact your internet service provider for instructions on how to turn OFF the wireless feature of your modem/router.
  - If your modem/router has an indicator light for the wireless feature, check that the light is OFF.
  - Later, if your router has one or two removable antennas, turn all power to the modem/router OFF, remove the antennas, and replace them with impedance-matched dummy loads, as a measure of protection against the accidental activation of the wireless feature. The dummy loads will absorb the radiofrequency power that would otherwise have been radiated by the antenna and turn that power into harmless heat.
    - Such activation can occur during a reset of the modem/router by you, or by your Internet service provider, who can do a reset remotely, because modem/routers default to wireless ON.
    - The dummy loads will not completely stop the radiation from the wireless feature, if that feature is ON, so it is still necessary to confirm periodically that the wireless feature is OFF.
    - You must correctly match the dummy loads to the impedance of the antenna outputs and to the connector type and gender of the antenna connectors on the modem/router. All antenna outputs on modem/routers that I have observed to date have an output impedance of 50 ohms. But you will need to identify the connector type and the gender. A common connector type and gender for the dummy load is RP-SMA, male.[2]
  - Some modem/routers employ an internal antenna only. You will not be able to use dummy loads with them, so be especially vigilant about assuring that the wireless feature of these modem/routers remains OFF.
  - Some modem/routers have a button that turns the wireless feature ON and OFF. That is a great convenience.

- Connect any other computers to your modem/router by Ethernet cables.

  - Unshielded Ethernet cable will be a huge improvement over wireless connectivity.
  - Shielded Ethernet cable is even better, but the shields are often not properly supported by wireless devices and thus may not produce their full benefit.[3]

- Turn OFF the wireless feature on any computers or laptops that you have.

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[2] The Verizon FIOS modem/routers, with one or two external antennas, observed to date, accept the RP-SMA 50 ohm dummy load, Amphenol 132360RP, available from Digi-Key.com as Part Number ACX1436-ND, for $4.77 each, plus shipping and sales tax (http://www.digikey.com/). Click HERE for direct access to the product's page on DigiKey's web site.

[3] For shielded Cat6 "patch" cables at affordable prices, see Cable Matters (http://www.cablematters.com/c-46-cat6-shielded-patch-cables.aspx). "Patch" cables come with the connectors already installed, which I recommend if you use shielded cables because installing connectors yourself on shielded cables is complicated. If you use unshielded cables, you may still wish to use "patch" cables to assure that all connections are made correctly. Because "patch" cables come with the connectors already installed, they are available in fixed lengths only, so more planning is needed before purchase.

- For more recent products, you will have to place them in “airplane mode” which will shut down both their Wi-Fi capability and their Bluetooth capability, if they have both.

- Establish wired connections between your computers and all peripherals.

  - If a given peripheral has both a wireless and a wired capability, determine if the wireless capability can be turned OFF. If so, turn that capability OFF.
  - If a given peripheral does not have a wired capability, replace it with one that does.
  - Consider all of these peripherals, at a minimum, as each may be wired or wireless, or both:
    - keyboard
    - mouse
    - printer
    - scanner

Tablet Computers and Book Readers

- Retire tablet computers and book readers that lack a wired capability.
  - All but one of these that I have seen so far rely solely on wireless capability.
  - I know of only one exception.[4] Let me know if you find other exceptions.
  - If you do want to use them, see if their wireless feature can be turned OFF when not needed.
  - Best to use them on a table top, rather than in your lap, even when their wireless feature has been turned OFF because all digital devices will radiate to some degree, so it is best to keep them as far from you as possible.

- If you use an Apple iPhone or iPad, see the Appendix 1 on page 15 for guidance on establishing a wired connection to the Internet. This will reduce the radiation they emit during Internet activity, such as browsing the web, downloading videos or other documents, and sending and receiving email.

Cell Phones/Smart Phones

I know of no way to use a cell phone safely. It is just too powerful, and it is located too close to you when in use. But the following suggestions may help to reduce your exposure:

- Demote your cell phone to emergency use, perhaps when you are on the road.
  - Fortunately, such limited use may be available at significantly lower cost than your current level of use.

[4] The Microsoft Surface Pro has a USB connector, to which can be connected a USB-to-Ethernet adapter, which facilitates a wired connection to the Internet. With airplane mode activated, this model emits no intentional RF. But, as with all digital electronic devices, it will emit some unintentional RF.

- If you must use a cell phone, use it as safely as possible, with techniques such as these:
  - Use in speakerphone mode.
  - Use with an "air tube headset" connected to the cell phone. This is an accessory that plugs into your cell phone's headset jack. It contains a miniature microphone and a miniature speaker, located near to the cell phone. A small-diameter plastic tube carries sound from the miniature speaker to one or both ears. A second small-diameter plastic tube picks up sound from your voice and carries it to the miniature microphone. The purpose is to allow you to hold the phone away from your head to lower the radiation that your head receives. But, of course, your entire body will still be irradiated, and those parts of your body closest to the phone, like your hand, will receive the highest radiation levels.
  - What about a wired microphone and earphone connected to the cell phone?[5] It is not clear to me how much of a benefit this approach will provide, because the wires will pick up some of the radiation and carry it to your head, which is the reason for the air-tube headset which won't do that.

- I doubt if a Bluetooth interface to your cell phone is much of a solution. Although Bluetooth is a lower-powered wireless radiator than a cell phone, Bluetooth will add its radiation to that of your cell phone, in return for enabling you to move the cell phone a bit farther from your head. But where will that cell phone be when you are using Bluetooth? Probably close to some other part of your body.

- If you must use a cellphone in a car or a truck,[6] consider the following:

  - Step outside the car or truck to place a cell phone call.
    Placing a call from inside a car or a truck will produce very high exposures to cellphone radiation for two reasons:

    The metal car body will cause multiple reflections within the vehicle, increasing your radiation exposure.

    Many cell phones are able to adjust their power output to the minimum needed to reach the nearest cell tower (presumably, to conserve battery power). When used inside a car, the metal car body blocks much of the radiation produced by the cell phone; so the cell phone will increase its power output in an attempt to

[5] Best Buy has "retro headsets" that are like the headsets on corded telephones, which can plug into cell phones, smart phones, tablet computers, and laptops equipped to accept them.

[6] In principle, using a cell phone with a rooftop antenna, mounted at the center of your roof, will reduce the radiation inside the vehicle considerably. But I have been unable to find a current cell phone model that has the necessary connection for an external antenna. If such a technique could be employed, it would place the region of strongest radiofrequency radiation outside of your vehicle. Also, cell phones with variable RF power output would likely operate successfully at lower output power with a rooftop antenna. An external antenna could be installed permanently on the center of the roof, or temporarily with a magnetic base to grip the roof without damaging it. The cable from the temporary antenna could pass into the vehicle through a slightly lowered window.

compensate, thereby increasing your radiation exposure.

- Shield your cell phone from your body when not in use.

    - When storing your cell phone, keep it inside a shielded enclosure. The reason for this is that some cell phones are still ON even when they are turned OFF. The reason for this is that they must report their position to the nearest cell tower to enable incoming calls to be received. Smart phones are especially troubling even when they are OFF because they may be maintaining contact with services providers related to their functions ("apps"), and they may be downloading updated software.
    - So called *cell phone wallets* are available. Make sure that the wallet is intended as a shield and that the wallet encloses the cell phone completely. If there are any openings, the wallet will not be as effective as a shield.

- If you use an Apple iPhone or iPad, see the Appendix 1 on page 15 for guidance on establishing a wired connection to the Internet. This will reduce the radiation they emit during Internet activity, such as browsing the web, downloading videos or other documents, and sending and receiving email.

Smart Meters and Other Wireless Utility Meters

Determining the radiation level of a given utility meter is very difficult for at least these reasons:

- There are many manufacturers, models, and options for the models.
- None of the meters contain labeling that clearly indicates the radiation level produced. It would be hard to label them because so much information would be required to specify their radiation level.
- The data that manufacturers offer on their web sites are invariably less than adequate to specify their radiation level.
- The Federal Communications Commission does require that an *FCC ID Number* be placed on each Smart Meter or other transmitting meter and does provide data on its web site that traces to that number. But the data provided are rarely adequate to determine a meter's radiation level.

For all of these reasons, it is best to discover as much as possible about the radiation level produced by a given meter by measuring that level while the meter is in service. (A different type of "meter" is required to measure the radiation -- a radiofrequency meter.) In most instances, this will be a job for a professional.

- If at all possible, have your Wireless Smart Meter replaced with a traditional analog mechanical meter with no wireless communications capability (which has no electronic, or "solid state", circuitry at all).

- This is the safest of all of the electricity meters made.
- For lower priority choices, see the analysis in the reference.[7] There are many factors to consider because there are so many types of utility meters.

- Inspect any current location in which you live, and any new location into which you contemplate moving, for the presence of wireless meters and other wireless devices of any kind. Again, actual measurement of the environment with a radiofrequency meter is best, not only to detect Wireless Smart Meters but also to detect the following:

  - wireless water meters
  - wireless gas meters
  - wireless devices that support wireless metering, such as
    - community-based collectors (that transfer data between the wireless meters and the electric power company)
    - community-based repeaters (that strengthen signals from the wireless meters so that the community-based collectors can gather them)
  - wireless devices not necessarily associated with the meters, such as
    - local cell towers
    - local Wi-Fi sources
    - many others.

- Be especially wary of apartments and condominiums which usually group utility meters in utility rooms or on a single outside wall. Such grouping creates very high radiation levels, especially for any nearby residential units. Again, measurement of the environment with a radiofrequency meter is needed.

New Electronic Products Generally

- Avoid purchasing new electronic products with built-in Wi-Fi or other wireless capability.

  - If you feel that you must purchase such products, then, before purchase, assure that their wireless capability can be turned OFF permanently.

  - You will need to monitor these products for their lifetime to assure that their wireless features remain OFF since most, if not all, will likely default to ON.

  - Examples
    - television sets
    - media players
    - DVD and Blu-ray players
    - security systems

[7] Ronald M. Powell, Ph.D., Ranking Electricity Meters for Risk to Health, Privacy, and Cyber Security (2015).

Automobiles

- Make sure all wireless capabilities of your car are turned OFF.

    - Bluetooth is the most likely one to be present.
    - Consult your owner's manual or the auto manufacturer to determine how to turn OFF any wireless capability.
    - When purchasing a new car, be sure to consult with the manufacturer to determine if the vehicle has any wireless capability and, if so, whether it can be turned OFF.
    - You will need to monitor such a car forever, to assure that its wireless capability is not inadvertently turned back ON, since ON may be the default state. (For example, when all power to the car's circuitry is cut during a battery replacement, memory of any settings that you have made may be lost, so the wireless features might default to ON when the new battery is installed.)

- Some cars may have active tire-pressure monitoring, using wireless technology; but I have not yet seen a measurable signal of concern from such devices.

Shut Down Unintentional Radiators

Unintentional radiators may produce radiation over a very wide range of frequencies, from power line frequencies (60 hertz) up through the frequencies used by intentional radiators (several gigahertz, or billions of hertz).

Shutting down unintentional radiators is more likely to require professional assistance than shutting down intentional radiators. A licensed electrician will know how to execute many of the fixes at power line frequencies (60 hertz), but he may or may not be able to identify that those fixes are needed. That may require a professional with expertise in electromagnetic fields.

As noted in the Introduction, do not attempt any work on the 60 hertz AC power system of your home unless you have the proper training and equipment.

Fluorescent and LED Lighting

- Replace fluorescent lighting with incandescent lighting.

    - One of the heartbreaks of energy efficiency devices is that so many of them produce a lot of unintentional radiation. Fluorescent lights are very efficient in producing light, but they produce a lot of unwanted radiation, too.
    - Incandescent lights, which are highly energy inefficient, produce minimal radiation. Even so, some incandescent lights with improved energy efficiency are available, even if they are not as efficient as fluorescent lighting.

- Inspect LED lighting for radiation and replace as needed.

    - LED lights are not inherently sources of radiation of concern, but the power supplies that power them often are. If those power supplies are switching types, then LED lights containing such power supplies will radiate.
    - Inspect them with an A.M. radio, as described in the section "Detecting Electromagnetic Fields near 1 Megahertz" on page14.
    - Replace them as needed, depending on what you find from the inspection.

Light Dimmers

- Replace light dimmers with regular wall switches.

    - All light dimmers for residential use, as far as I know, use solid-state electronic circuitry to control the flow of power to lights[8] and, in the process, generate dirty electricity and radiofrequency radiation.

- To my knowledge, there are no household products available for light dimming that do not produce such radiation, even though some implementations will be better than others. Custom solutions, however, are possible.[9]

Light Timers

- Replace programmable light timers with safe ones.

    - All programmable light timers that use electronic circuitry (solid state electronics) to control the flow of power to lights generate some dirty electricity and radiofrequency radiation in the process.

- But there is at least one programmable light timer that employs a battery-operated solid state timer and a solenoid-operated mechanical switch to turn power ON or OFF. It appears to be quite safe.[10]

Wall AC-to-DC Power Supplies Containing Switching Technology

- Check all wall power supplies for RF radiation.

    - Sadly, most of these contain switching technology that creates some dirty electricity

[8] Phase-control dimmers are probably the most common and make a lot of dirty electricity.
[9] Light dimming can be accomplished by methods that do not generate significant radiation, but such products, as far as I can determine, are not sold for residential applications. Rather a custom design by an electrical engineer will be required.
[10] Intermatic ST01 Series (http://www.intermatic.com/en/Products/Timers/InWallTimers/Electronic_Timers/ST01_Series.aspx).

and places some RF radiation directly into the air.
    - You can use an A.M. radio to get some idea of which wall transformers are radiating. See the comment about using an A.M. radio in the section "Detecting Electromagnetic Fields near 1 Megahertz" on page 14.

- This is difficult to fix. But replacing the worst of wall transformers with linear dc power supplies can help, where proper matches of the required electrical characteristics can be obtained. This may be more than a licensed electrician can do and may require the assistance of an electrical engineer.

House Wiring Errors

- Check house for wiring errors that can produce anomalously high AC magnetic fields running along that wiring.

    - If two neutrals from different circuit breakers (that is, different circuits) have been connected (a violation of the electrical code), imbalanced current flows will occur in both of the connected circuits, preventing the normal, and desirable, cancellation of magnetic fields from occurring.
    - Checking for such errors will require instrumentation for measuring low frequency AC magnetic fields. This is a job best done by a professional who then either makes the needed corrections in the house wiring or instructs a licensed electrician to do so.

Computers, Their Displays, and Their Accessories

Computers, their displays, and their accessories produce unintentional radiation all of the time, even if they include no wireless devices. Just bring an A.M. radio near any of them to see that this is true. They contain very high speed electronic circuitry which inherently broadcasts radiofrequency radiation all of the time. And they are universally powered by switching power supplies that produce dirty electricity and electromagnetic radiation. Reducing the radiation they emit is very difficult, indeed. Some colleagues have learned much about how to do this, but it is an expensive and complicated process.

The single most important step you can take to protect yourself is to put as much distance between you and the components of your computer as you can. So for example, you might have your display, keyboard, and mouse on the table in front of you, but not the computer itself or its backup power supply. Place them as far away as you can.

Turn Off Electronic Products When Not In Use

Whether electronic products are intentional radiators or unintentional radiators, some remain ON even when they are turned OFF and others cannot be turned OFF without unplugging them.

Backup power supplies are examples of the former, and wall AC-to-DC power supplies are examples of the latter. For such products, you can plug them into a special switch and plug that special switch into the wall.[11] That will enable you to turn them OFF with the inserted switch whenever they are not needed. A power strip with a switch is a convenient way to turn OFF multiple appliances that were already grouped together around a single outlet. Shutting these down, particularly at nighttime, is recommended.

Shielding

Professional help is recommended when attempting to install shielding, because --

- Special knowledge is required.
- Measurement instrumentation is required to assure that progress is being made.
- Special materials are required, and some of them can be expensive. Different materials are needed for different frequencies.
- A given situation can be made worse, instead of better, if the shielding is done incorrectly.

Measuring Electromagnetic Fields

Measuring Electromagnetic Fields is also a huge topic that I hope to address later, but here are just a few comments.

Professional help is again highly desirable because --

- Special knowledge is required.
- A lot of special equipment will be required to evaluate an environment properly because a single instrument will be able to measure only limited characteristics of that environment, such as

    - certain frequencies
    - certain types of waveforms, such as analog versus digital waveforms
    - certain characteristics of those waveforms, such as
        - peak radiofrequency power density
        - time-average radiofrequency power density
        - pulse duration.

[11] There are many switches on the market for this purpose. One is the GE Handy Switch, Model 52159, without a ground but polarized, and another is the GE Handy Switch, Model 52149 with a ground. Prices are high for such a simple device, up to $9.00 each, but I have seen them for as little as about $2.50 on Amazon from some suppliers.

Detecting Electromagnetic Fields near 1 Megahertz

A battery operated handheld A.M. radio can serve as a useful detector of the presence of electromagnetic fields within its frequency range of about 520 kilohertz to 1710 kilohertz. (1 kilohertz is 1000 hertz). This range is equivalent to 0.520 megahertz to 1.710 megahertz. (1 megahertz is 1 million hertz.)

To use this method, turn the A.M. radio ON and approach a suspicious source. Check particularly at the lowest frequency of the A.M. radio and at the highest frequency of the A.M. radio, if there is no station at those frequencies. Listen for what is usually an unpleasant sound. To verify that the suspected source is the true source of the sound, turn OFF the power to the source and see if the sound dies, or move the radio away from the source and see if the sound level decreases.

Rotate the A.M. radio around to see if the sound increases or decreases in volume. The signal will have a characteristic direction that will cause the sound level to change. That is, some orientations of the A.M. radio will pick up a given signal better than others, as indicated by a louder sound.

You can use this technique to inspect wall AC-to-DC power supplies, programmable timers, light dimmers, and the wiring in the walls for the radiation that these types of devices produce. You will invariably find radiation near just about any digital electronic product, such as computers and liquid crystal displays.

The presence of a signal on the A.M. radio does not preclude the presence of radiation at frequencies outside of the range of the A.M. radio. Computers and other digital devices produce radiation over a broad range of frequencies.

Appendix 1
How to reduce RF/microwave radiation exposure from the Apple iPad or iPhone by using a wired Ethernet connection to the Internet

Several videos on the Internet show that it is possible to establish a wired Ethernet connection between your Apple iPad or Apple iPhone and the Internet. Once a wired connection is established, these products may be placed in “airplane mode” which shuts down all of their wireless signals, including Wi-Fi, Bluetooth, and cell phone. Of course, in this mode, you cannot place phone calls or send text messages, both of which require a wireless connection to a cell tower. But once a wired Ethernet connection to the Internet has been established, you can turn off the Wi-Fi signal from the router that you were using to communicate with these products, further reducing your radiation exposure. The wired connection will generally provide download speeds that are much higher than the wireless Wi-Fi connection, so you may find yourself delightfully spoiled in short order.

While a wired connection limits mobility, not all mobility is lost. You can download many video, audio, and data sources through the new wired connection, and then disconnect your iPad or iPhone from that wired connection and take it wherever you want to view or read the downloaded material. In the meantime, your iPhone or iPad can remain in “airplane mode”.

The criterion that each iPhone or iPad must meet to enable the wired connection described here is this: The iPhone or iPad must have the tiny 8-pin female connector called the Apple "Lightning" connector. That connector appears on the more recent Apple products. If there are other criteria of importance, they have not yet surfaced.

The steps required to make a wired Ethernet connection to the Internet are described by Paul Harding of Total EMF Solutions in Phoenix, Arizona in a video. His web site and his video are provided here.

http://www.totalemfsolutions.com/about.html
https://www.youtube.com/watch?v=CG4xh9Gm7jE

There are three components required to make the wire connection described in his video. The two Apple components must be the actual Apple products for success. I list all three components below and provide the pricing from a mail-order vendor, B&H Photo in New York. The total parts cost is $73.

(1) The Apple "Lightning to USB Camera Adapter" $27.99

This adapter has a male "Lightning" connector on one end and a female USB connector on the other end.

B&H # APMLUCADP MFR # MD821AM/A

($27.99, including shipping)

(2) The Apple "USB Ethernet Adapter"

This adapter has a male USB connector on one end and a female Ethernet connector on the other end.

B&H # APMC704LLA MFR # MC704LL/A
($29.00, including shipping)

(3) A powered USB 2.0 Hub

It is likely that any powered USB 2.0 Hub will work. Below is one suggestion that is relatively inexpensive.

Belkin 4-Port USB 2.0 Mobile Hub, Model F5U404PBLK
B&H # BEF5U404PBLK MFR # F5U404PBLK ($15.99, including shipping)

It would be great if the Apple USB Ethernet Adapter could be plugged directly into the Apple "Lightning to USB Camera Adapter". While the connectors enable such a physical connection, the result will not work. The reason is that the Apple iPad and the Apple iPhone cannot power the Apple "USB Ethernet Adapter". That is why a powered USB hub MUST be connected between the two. When everything is connected as shown in the video, the powered USB hub will power the "USB Ethernet Adapter" but will not feed power back to the iPhone or the iPad through the "Lightning to USB Camera Adapter".

In essence, stringing these three components together produces a "Lightning to Ethernet Adapter". Unfortunately, Apple does not provide such an adapter as a single product; if Apple did so, that adapter would likely have to be externally powered.

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